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U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

ATTORNEY'S DOCKET NUMBER

TRANSMITTAL LETTER TO THE UNITED STATES
DESIGNATED/ELECTED OFFICE (DO/EO/US)
CONCERNING A FILING UNDER 35 U.S.C. 371

DEX-0180

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR

09/806302

INTERNATIONAL APPLICATION NO.
PCT/US99/22753INTERNATIONAL FILING DATE
30 September 1999PRIORITY DATE CLAIMED
2 October 1998

TITLE OF INVENTION

A Novel Method of Diagnosing, Monitoring, Staging, Imaging and Treating Gynecologic Cancers

APPLICANT(S) FOR DO/EO/US

MACINA, Roberto A.

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☐ This is an express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. 371 (c) (2))
 - a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
 - b. ☐ has been transmitted by the International Bureau.
 - c. ☒ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☐ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. ☒ A copy of the International Search Report (PCT/ISA/210).
8. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
 - a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
 - b. ☐ have been transmitted by the International Bureau.
 - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
 - d. ☒ have not been made and will not be made.
9. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
10. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)). - **unexecuted**
11. ☒ A copy of the International Preliminary Examination Report (PCT/IPEA/409).
12. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).

Items 13 to 20 below concern document(s) or information included:

13. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
14. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
15. ☐ A **FIRST** preliminary amendment.
16. ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
17. ☐ A substitute specification.
18. ☐ A change of power of attorney and/or address letter.
19. ☐ Certificate of Mailing by Express Mail
20. ☒ Other items or information:

- 1) Courtesy copy of International Application
- 2) Return post card

"Express Mail" Label No. EL846058750US
Date of Deposit March 29, 2001

I hereby certify that this paper is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 on the date indicated above and is addressed to the Assistant Commissioner for Patents, Box PCT, Washington, D.C. 20231.

By

Deborah Ehret

Typed Name: Deborah Ehret

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21. The following fees are submitted:

CALCULATIONS PTO USE ONLY

BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :

- ☐ Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO \$1,000.00
- ☒ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO \$860.00
- ☐ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO \$710.00
- ☐ International preliminary examination fee paid to USPTO (37 CFR 1.482) but all claims did not satisfy provisions of PCT Article 33(1)-(4) \$690.00
- ☐ International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4) \$100.00

ENTER APPROPRIATE BASIC FEE AMOUNT =**\$860.00**

Surcharge of \$130.00 for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (e)).

\$0.00

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE
Total claims	10 - 20 =	0	x \$18.00
Independent claims	7 - 3 =	4	x \$80.00

\$0.00**\$320.00**

Multiple Dependent Claims (check if applicable).

\$0.00**TOTAL OF ABOVE CALCULATIONS =****\$1,180.00**

Reduction of 1/2 for filing by small entity, if applicable. Verified Small Entity Statement must also be filed (Note 37 CFR 1.9, 1.27, 1.28) (check if applicable).

☐**\$0.00****SUBTOTAL =****\$1,180.00**

Processing fee of \$130.00 for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (f)).

\$0.00**TOTAL NATIONAL FEE =****\$1,180.00**

Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) (check if applicable).

☐**\$0.00****TOTAL FEES ENCLOSED =****\$1,180.00**

Amount to be:
refunded \$
charged \$

☐ A check in the amount of _____ to cover the above fees is enclosed.

☒ **Credit Card Payment form for \$1,180.00**

☐ Please charge my Deposit Account No. _____ in the amount of _____ to cover the above fees.
A duplicate copy of this sheet is enclosed.

☒ The Commissioner is hereby authorized to charge any fees which may be required, or credit any overpayment to Deposit Account No. **50-1619** A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

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REGISTRATION NUMBER

March 29, 2001

DATE

**A NOVEL METHOD OF DIAGNOSING, MONITORING, STAGING, IMAGING
AND TREATING GYNECOLOGIC CANCERS**

FIELD OF THE INVENTION

This invention relates, in part, to newly developed
5 assays for detecting, diagnosing, monitoring, staging,
prognosticating, imaging and treating cancers, particularly
gynecologic cancers including endometrial, mammary, ovary and
uterine cancer.

BACKGROUND OF THE INVENTION

10 In women, gynecologic cancers account for more than one-
fourth of the malignancies.

For example, endometrial cancer occurs at a rate of
approximately 44,500 new cases per year with approximately
10,000 deaths per year. If diagnosed and treated early, when
15 the cancer is still confined to the endometrium, cure can be
achieved in approximately 95% of the cases by hysterectomy.
Pap smears can show endometrial cancers but are effective in
only 50% of the cases. For the remainder, abnormal vaginal
bleeding is typically the first clinical sign of endometrial
20 cancer.

Sarcoma of the uterus, a very rare kind of cancer in
women, is a disease in which cancer (malignant) cells start
growing in the muscles or other supporting tissues of the
uterus. Sarcoma of the uterus is different from cancer of the
25 endometrium, a disease in which cancer cells start growing in
the lining of the uterus. Women who have received therapy
with high-dose x-rays (external beam radiation therapy) to
their pelvis are at a higher risk to develop sarcoma of the
uterus. These x-rays are sometimes given to women to stop
30 bleeding from the uterus. Like most cancers, sarcoma of the
uterus is best treated when it is found (diagnosed) early.
Sarcoma of the uterus usually begins after menopause. When

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a patient has signs of such cancer, an internal pelvic examination is usually performed to detect any lumps or changes in shape of the pelvic organs. A Pap test may also be performed, however because sarcoma of the uterus begins
5 inside the organ, this cancer is not usually detected by the Pap test. A dilation and curettage (D&C) may also be performed and a biopsy sample taken and examined microscopically.

It is estimated that one of every nine women in America
10 will develop breast cancer sometime during her life based on a lifespan of 85 years. Annually, over 180,000 women in the United States are diagnosed with breast cancer and approximately 46,000 die from this disease. Every woman is at risk for breast cancer. However, a woman's chances of
15 developing breast cancer increase as she grows older; 80 percent of all cancers are found in women over the age of 50. There are also several risk factors that can increase a woman's chances of developing breast cancer. These include a family history of breast cancer, having no children or the
20 first child after the age of 30, and an early start of menstruation. However, more than 70 percent of women who develop breast cancer have no known risk factors. Less than 10 percent of breast cancer cases are thought to be related to the BRCA1 gene discovered in 1994. Researchers are now
25 investigating the role of other factors such as nutrition, alcohol, exercise, smoking, and oral contraceptives in development of this gynecologic cancer. Mammograms, or special x-rays of the breast, can detect more than 90 percent of all cancers.

30 Carcinoma of the ovary is another very common gynecologic cancer. In fact, ovarian cancer causes more deaths than any other cancer of the female reproductive system. Approximately one in 70 women develop ovarian cancer during their lifetime. An estimated 14,500 deaths in 1995
35 resulted from ovarian cancer. Ovarian cancer often does not

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cause any noticeable symptoms. Possible warning signals include an enlarged abdomen due to an accumulation of fluid or vague digestive disturbances (discomfort, gas or distention) in women over 40. In rare cases abnormal vaginal bleeding also occurs. Pap tests do not detect ovarian cancer. Thus, periodic, complete pelvic examinations are important and recommended annually for women over 40.

In all of these gynecologic cancers, chances of survival are much better if the cancer is diagnosed at an early stage. Further, treatment decisions for the individual are linked to the stage of the cancer present in that individual. However, current cancer staging methods are limited and some such cancers initially staged as not metastatic are actually metastatic. Discovery of metastasis is significant because patients with metastatic cancers have a poorer prognosis and require significantly different therapy than those with localized cancers.

Accordingly, there is a great need for sensitive and accurate methods for early detection and staging of gynecologic cancers such as endometrial, breast, uterine and ovarian cancer in a human to determine whether or not such cancer has metastasized and for monitoring the progress of such cancer in a human which has not metastasized for the onset of metastasis.

Steroid binding proteins, including uteroglobin and CC10, are a class of proteins which bind steroids along with methylsulfonyl metabolites of polychlorinated biphenyls. The exact function of members of this class of protein is uncertain. However, uteroglobin has been shown to inhibit PLA₂ mediated responses.

Gene and gene products homologous to uteroglobin are described in WO 97/34997 entitled Human Endometrial Specific Steroid Binding Factors I, II and III. The genes and their encoded products are referred to as Human Endometrial Specific Steroid-Binding Factors I, II and III (hESF I, II, and III).

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Methods for utilizing these genes and gene products in research and diagnostic and clinical arts are disclosed. In particular, methods for detecting mutations in the hESFI, II or III gene or altered protein expression resulting from a mutant gene are indicated to be useful in diagnosing susceptibility to asthma and endometrial cancer.

A gene and gene product homologous to uteroglobin and very similar to hESF III, referred to as human mammoglobin homolog or HGH, is also described in WO 99/19487. The human mammoglobin homolog is suggested to be useful for the diagnosis, prevention and treatment of neoplastic disorders and endometriosis.

It has now been found that detection of hESF III, referred to herein as ESBPIII, is useful in diagnosing, monitoring, staging, prognosticating, imaging and treating cancers, particularly gynecologic cancers including endometrial, mammary, ovary and uterine cancer.

Accordingly, in the present invention, methods are provided for detecting, diagnosing, monitoring, staging, prognosticating, imaging and treating gynecologic cancers via ESBPIII. ESBPIII refers, among other things, to native protein expressed by the gene comprising the polynucleotide sequence of SEQ ID NO:1. The amino acid sequence of a polypeptide encoded by SEQ ID NO:1 is depicted herein as SEQ ID NO:2. In the alternative, what is meant by the ESBPIII as used herein, means the native mRNA encoded by the gene comprising the polynucleotide sequence of SEQ ID NO:1 or levels of the gene comprising the polynucleotide sequence of SEQ ID NO:1.

Other objects, features, advantages and aspects of the present invention will become apparent to those of skill in the art from the following description. It should be understood, however, that the following description and the specific examples, while indicating preferred embodiments of the invention are given by way of illustration only. Various

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changes and modifications within the spirit and scope of the disclosed invention will become readily apparent to those skilled in the art from reading the following description and from reading the other parts of the present disclosure.

5 SUMMARY OF THE INVENTION

Toward these ends, and others, it is an object of the present invention to provide a method for diagnosing the presence of gynecologic cancers by analyzing for changes in levels of ESBPIII in cells, tissues or bodily fluids compared
10 with levels of ESBPIII in preferably the same cells, tissues, or bodily fluid type of a normal human control, wherein a change in levels of ESBPIII in the patient versus the normal human control is associated with a gynecologic cancer.

Further provided is a method of diagnosing a metastatic
15 gynecologic cancer in a patient which is not known to have metastasized by identifying a human patient suspected of having a gynecologic cancer that has metastasized; analyzing a sample of cells, tissues, or bodily fluid from such patient for ESBPIII; and comparing the ESBPIII levels in such cells,
20 tissues, or bodily fluid with levels of ESBPIII in preferably the same cells, tissues, or bodily fluid type of a normal human control, wherein an increase in ESBPIII levels in the patient versus the normal human control is associated with a gynecologic cancer which has metastasized.

Also provided by the invention is a method of staging
25 gynecologic cancers in a human by identifying a human patient having a gynecologic cancer; analyzing a sample of cells, tissues, or bodily fluid from such patient for ESBPIII; comparing ESBPIII levels in such cells, tissues, or bodily
30 fluid with levels of ESBPIII in preferably the same cells, tissues, or bodily fluid type of a normal human control, wherein an increase in ESBPIII levels in the patient versus the normal human control is associated with a cancer which is progressing and a decrease in the levels of ESBPIII is

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associated with a cancer which is regressing or in remission.

Further provided is a method of monitoring gynecologic cancers in a human having such cancer for the onset of metastasis. The method comprises identifying a human patient
5 having such cancer that is not known to have metastasized; periodically analyzing a sample of cells, tissues, or bodily fluid from such patient for ESBPIII; comparing the ESBPIII levels in such cells, tissue, or bodily fluid with levels of ESBPIII in preferably the same cells, tissues, or bodily fluid
10 type of a normal human control, wherein an increase in ESBPIII levels in the patient versus the normal human control is associated with a cancer which has metastasized.

Further provided is a method of monitoring the change in stage of a gynecologic cancer in a human patient by
15 monitoring levels of ESBPIII in the patient. The method comprises identifying a human patient having a gynecologic cancer; periodically analyzing a sample of cells, tissues, or bodily fluid from such patient for ESBPIII; comparing the ESBPIII levels in such cells, tissue, or bodily fluid with
20 levels of ESBPIII in preferably the same cells, tissues, or bodily fluid type of a normal human control sample, wherein an increase in ESBPIII levels in the patient versus the normal human control is associated with a cancer which is progressing and a decrease in the levels of ESBPIII is associated with a
25 cancer which is regressing or in remission.

Further provided are antibodies which specifically bind ESBPIII or fragments of such antibodies which can be used to detect or image localization of ESBPIII in a patient for the purpose of detecting or diagnosing a disease or condition.
30 Such antibodies can be polyclonal, monoclonal, or omniclonal or prepared by molecular biology techniques. The term "antibody", as used herein and throughout the instant specification is also meant to include aptamers and single-stranded oligonucleotides such as those derived from an in
35 vitro evolution protocol referred to as SELEX and well known

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to those skilled in the art. Antibodies can be labeled with a variety of detectable labels including, but not limited to, radioisotopes and paramagnetic metals. These antibodies or fragments thereof can also be used as therapeutic agents in the treatment of diseases characterized by expression of ESBPIII. In therapeutic applications, the antibody can be used without or with derivatization to a cytotoxic agent such as a radioisotope, enzyme, toxin, drug or a prodrug.

Other objects, features, advantages and aspects of the present invention will become apparent to those of skill in the art from the following description. It should be understood, however, that the following description and the specific examples, while indicating preferred embodiments of the invention, are given by way of illustration only. Various changes and modifications within the spirit and scope of the disclosed invention will become readily apparent to those skilled in the art from reading the following description and from reading the other parts of the present disclosure.

DETAILED DESCRIPTION OF THE INVENTION

The present invention relates to diagnostic assays and methods, both quantitative and qualitative for detecting, diagnosing, monitoring, staging and prognosticating cancers by comparing levels of ESBPIII with those of ESBPIII in a normal human control. What is meant by levels of ESBPIII as used herein, means levels of the native protein expressed by the gene comprising the polynucleotide sequence of SEQ ID NO: 1. The protein encoded by this polynucleotide is depicted in SEQ ID NO: 2. In the alternative, what is meant by levels of ESBPIII as used herein, means levels of the native mRNA encoded by the gene comprising the polynucleotide sequence of SEQ ID NO: 1 or levels of the gene comprising the polynucleotide sequence of SEQ ID NO:1. Such levels are preferably measured in at least one of cells, tissues and/or bodily fluids, including determination of normal and abnormal

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levels. Thus, for instance, a diagnostic assay in accordance with the invention for diagnosing overexpression of ESBPIII protein compared to normal control bodily fluids, cells, or tissue samples may be used to diagnose the presence of
5 cancers, in particular gynecologic cancers including breast, uterine, ovarian and endometrial cancer.

All the methods of the present invention may optionally include measuring levels of other cancer markers as well as ESBPIII. Other cancer markers, in addition to ESBPIII, useful
10 in the present invention will depend on the cancer being tested and are known to those of skill in the art.

Diagnostic Assays

The present invention provides methods for diagnosing the presence of a gynecologic cancer such as uterine, breast,
15 endometrial or ovarian cancer by analyzing for changes in levels of ESBPIII in cells, tissues or bodily fluids compared with levels of ESBPIII in cells, tissues or bodily fluids of preferably the same type from a normal human control, wherein a change in levels of ESBPIII in the patient versus the normal
20 human control is associated with the presence of a gynecologic cancer.

Without limiting the instant invention, typically, for a quantitative diagnostic assay a positive result indicating the patient being tested has cancer is one in which cells,
25 tissues or bodily fluid levels of a cancer marker, such as ESBPIII, are at least two times higher, and most preferably are at least five times higher, than in preferably the same cells, tissues or bodily fluid of a normal human control.

The present invention also provides a method of
30 diagnosing the onset of metastasis of gynecologic cancers in a patient having a gynecologic cancer which has not yet metastasized. In the method of the present invention, a human cancer patient suspected of having a gynecologic cancer which may have metastasized (but which was not previously known to
35 have metastasized) is identified. This is accomplished by a

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variety of means known to those of skill in the art.

In the present invention, determining the presence of ESBPIII levels in cells, tissues or bodily fluid, is particularly useful for discriminating between a gynecologic cancer which has not metastasized and a gynecologic cancer which has metastasized. Existing techniques have difficulty discriminating between gynecologic cancers which have metastasized and gynecologic cancers which have not metastasized. However, proper treatment selection is often dependent upon such knowledge.

In the present invention, the cancer marker level measured in such cells, tissues or bodily fluid is ESBPIII. Measure ESBPIII levels in a human patient are compared with levels of ESBPIII in preferably the same cells, tissue or bodily fluid type of a normal human control. That is, if the cancer marker being observed is ESBPIII in serum, this level is preferably compared with the level of ESBPIII in serum of a normal human control. An increase in the ESBPIII in the patient versus the normal human control is associated with a gynecologic cancer which has metastasized.

Without limiting the instant invention, typically, for a quantitative diagnostic assay a positive result indicating the cancer in the patient being tested or monitored has metastasized is one in which levels of a cancer marker such as ESBPIII in cells, tissues or bodily fluid from the patient are at least two times higher, and most preferably are at least five times higher, than in preferably the same cells, tissues or bodily fluid of a normal human control.

Normal human control as used herein includes a human patient without cancer and/or non cancerous samples from the patient; in the methods for diagnosing or monitoring for metastasis, normal human control may preferably also include samples from a human patient that is determined by reliable methods to have uterine, breast, ovarian or endometrial cancer which has not metastasized.

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Staging

The invention also provides a method of staging a gynecologic cancer in a human patient. The method comprises identifying a human patient having such cancer and analyzing
5 cells, tissues or bodily fluid from the patient for ESBPIII. The measured ESBPIII levels in such cells, tissues or bodily fluid from the patient are then compared with levels of ESBPIII in preferably the same cells, tissues or bodily fluid
10 type of a normal human control, wherein an increase in ESBPIII levels in the human patient versus the normal human control is associated with a cancer which is progressing and a decrease in the levels of ESBPIII is associated with a cancer which is regressing or in remission.

Monitoring

Further provided is a method of monitoring gynecologic
15 cancers in a human patient having such cancer for the onset of metastasis. The method comprises identifying a human patient having such cancer that is not known to have metastasized; periodically analyzing cells, tissues or bodily
20 fluid from such human patient for ESBPIII; and comparing the ESBPIII levels in such cells, tissues or bodily fluid with levels of ESBPIII in preferably the same cells, tissues or bodily fluid type of a normal human control, wherein an increase in ESBPIII levels in the human patient versus the
25 normal human control is associated with a cancer which has metastasized.

Further provided by this invention is a method of monitoring the change in stage of a gynecologic cancer in a human patient having such cancer. The method comprises
30 identifying a human patient having such cancer; periodically analyzing cells, tissues or bodily fluid from such human patient for ESBPIII; comparing the ESBPIII levels in such cells, tissues or bodily fluid with levels of ESBPIII in preferably the same cells, tissues or bodily fluid type of a
35 normal human control, wherein an increase in ESBPIII levels

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in the human patient versus the normal human control is associated with a cancer which is progressing in stage and a decrease in the levels of ESBPIII is associated with a cancer which is regressing in stage or in remission.

- 5 Monitoring patients for onset of metastasis is periodic and preferably done on a quarterly basis. However, this may be more or less frequently depending on the cancer, the particular patient, and the stage of the cancer.

Assay Techniques

- 10 Assay techniques that can be used to determine levels of gene expression (including protein levels), such as ESBPIII in the present invention, in a sample derived from a patient are well known to those of skill in the art. Such assay methods include, without limitation, radioimmunoassays,
15 reverse transcriptase PCR (RT-PCR) assays, immunohistochemistry assays, *in situ* hybridization assays, competitive-binding assays, Western Blot analyses, ELISA assays and proteomic approaches: two-dimensional gel electrophoresis (2D electrophoresis) and non-gel based
20 approaches such as mass spectrometry or protein interaction profiling. Among these, ELISAs are frequently preferred to diagnose a gene's expressed protein in biological fluids.

- An ELISA assay initially comprises preparing an antibody, if not readily available from a commercial source, specific
25 to ESBPIII, preferably a monoclonal antibody. In addition, a reporter antibody generally is prepared which also binds specifically to ESBPIII. The reporter antibody is attached to a detectable reagent such as radioactive, fluorescent or enzymatic reagent. For example, horseradish peroxidase enzyme
30 or alkaline phosphatase are routinely used as detectable reagents.

- To carry out the ELISA, antibody specific to ESBPIII is incubated on a solid support, e.g. a polystyrene dish, that binds the antibody. Any free protein binding sites on the
35 dish are then covered by incubating with a non-specific

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protein such as bovine serum albumin. Next, the sample to be analyzed is incubated in the dish, during which time ESBPIII binds to the specific antibody attached to the polystyrene dish. Unbound sample is washed out with buffer. A reporter antibody specifically directed to ESBPIII and linked to a detectable reagent such as horseradish peroxidase is placed in the dish resulting in binding of the reporter antibody to any monoclonal antibody bound to ESBPIII. Unattached reporter antibody is then washed out. Reagents for peroxidase activity, including a colorimetric substrate are then added to the dish. Immobilized peroxidase, linked to ESBPIII antibodies, produces a colored reaction product. The amount of color developed in a given time period is proportional to the amount of ESBPIII protein present in the sample. Quantitative results typically are obtained by reference to a standard curve.

A competition assay can also be employed wherein antibodies specific to ESBPIII are attached to a solid support and labeled ESBPIII and a sample derived from the host are passed over the solid support. The amount of label detected which is attached to the solid support can be correlated to a quantity of ESBPIII in the sample.

Nucleic acid methods can also be used to detect ESBPIII mRNA as a marker for gynecologic cancers such as uterine, breast, endometrial and ovarian cancer. Polymerase chain reaction (PCR) and other nucleic acid methods, such as ligase chain reaction (LCR) and nucleic acid sequence based amplification (NASABA), can be used to detect malignant cells for diagnosis and monitoring of various malignancies. For example, reverse-transcriptase PCR (RT-PCR) is a powerful technique which can be used to detect the presence of a specific mRNA population in a complex mixture of thousands of other mRNA species. In RT-PCR, an mRNA species is first reverse transcribed to complementary DNA (cDNA) with use of the enzyme reverse transcriptase; the cDNA is then amplified

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as in a standard PCR reaction. RT-PCR can thus reveal by amplification the presence of a single species of mRNA. Accordingly, if the mRNA is highly specific for the cell that produces it, RT-PCR can be used to identify the presence of
5 a specific type of cell.

Hybridization to clones or oligonucleotides arrayed on a solid support (i.e. gridding) can be used to detect the expression of and quantitate the level of expression of that gene. In this approach, a cDNA encoding the ESBPIII gene is
10 fixed to a substrate. The substrate may be of any suitable type including but not limited to glass, nitrocellulose, nylon or plastic. At least a portion of the DNA encoding the ESBPIII gene is attached to the substrate and then incubated with the analyte, which may be RNA or a complementary DNA
15 (cDNA) copy of the RNA, isolated from the tissue of interest. Hybridization between the substrate bound DNA and the analyte can be detected and quantitated by several means including, but not limited to, radioactive labeling or fluorescence labeling of the analyte or a secondary molecule designed to
20 detect the hybrid. Quantitation of the level of gene expression can be done by comparison of the intensity of the signal from the analyte compared with that determined from known standards. The standards can be obtained by *in vitro* transcription of the target gene, quantitating the yield, and
25 then using that material to generate a standard curve.

Of the proteomic approaches, 2D electrophoresis is a technique well known to those in the art. Isolation of individual proteins from a sample such as serum is accomplished using sequential separation of proteins by
30 different characteristics usually on polyacrylamide gels. First, proteins are separated by size using an electric current. The current acts uniformly on all proteins, so smaller proteins move farther on the gel than larger proteins. The second dimension applies a current perpendicular to the
35 first and separates proteins not on the basis of size but on

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the specific electric charge carried by each protein. Since no two proteins with different sequences are identical on the basis of both size and charge, the result of a 2D separation is a square gel in which each protein occupies a unique spot.

- 5 Analysis of the spots with chemical or antibody probes, or subsequent protein microsequencing can reveal the relative abundance of a given protein and the identity of the proteins in the sample.

The above tests can be carried out on samples derived
10 from a variety of cells, bodily fluids and/or tissue extracts (homogenates or solubilized tissue) obtained from a patient including tissue biopsy and autopsy material. Bodily fluids useful in the present invention include blood, urine, saliva or any other bodily secretion or derivative thereof. Blood
15 can include whole blood, plasma, serum or any derivative of blood.

In Vivo Antibody Use

Antibodies against ESBPIII can also be used *in vivo* in patients suspected of suffering from gynecologic cancers such
20 as ovarian, breast, endometrial and uterine cancer. Specifically, antibodies against a ESBPIII can be injected into a patient suspected of having a gynecologic cancer for diagnostic and/or therapeutic purposes. The use of antibodies for *in vivo* diagnosis is well known in the art. For example,
25 antibody-chelators labeled with Indium-111 have been described for use in the radioimmunoscentographic imaging of carcinoembryonic antigen expressing tumors (Sumerdon et al. Nucl. Med. Biol. 1990 17:247-254). In particular, these antibody-chelators have been used in detecting tumors in
30 patients suspected of having recurrent colorectal cancer (Griffin et al. J. Clin. Onc. 1991 9:631-640). Antibodies with paramagnetic ions as labels for use in magnetic resonance imaging have also been described (Lauffer, R.B. Magnetic

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Resonance in Medicine 1991 22:339-342). Antibodies directed against ESBPIII can be used in a similar manner. Labeled antibodies against ESBPIII can be injected into patients suspected of having a gynecologic cancer for the purpose of

5 diagnosing or staging of the disease status of the patient. The label used will be selected in accordance with the imaging modality to be used. For example, radioactive labels such as Indium-111, Technetium-99m or Iodine-131 can be used for planar scans or single photon emission computed tomography

10 (SPECT). Positron emitting labels such as Fluorine-19 can be used in positron emission tomography. Paramagnetic ions such as Gadolinium (III) or Manganese (II) can be used in magnetic resonance imaging (MRI). Localization of the label permits determination of the spread of the cancer. The amount of

15 label within an organ or tissue also allows determination of the presence or absence of cancer in that organ or tissue.

For patients diagnosed with a gynecologic cancer, injection of an antibody against ESBPIII can also have a therapeutic benefit. The antibody may exert its therapeutic

20 effect alone. Alternatively, the antibody is conjugated to a cytotoxic agent such as a drug, toxin or radionuclide to enhance its therapeutic effect. Drug monoclonal antibodies have been described in the art for example by Garnett and Baldwin, Cancer Research 1986 46:2407-2412. The use of toxins

25 conjugated to monoclonal antibodies for the therapy of various cancers has also been described by Pastan et al. Cell 1986 47:641-648. Yttrium-90 labeled monoclonal antibodies have been described for maximization of dose delivered to the tumor while limiting toxicity to normal tissues (Goodwin and Meares

30 Cancer Supplement 1997 80:2675-2680). Other cytotoxic radionuclides including, but not limited to Copper-67, Iodine-131 and Rhenium-186 can also be used for labeling of antibodies against ESBPIII.

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Antibodies which can be used in these *in vivo* methods include both polyclonal, monoclonal or omniclonal antibodies and antibodies prepared via molecular biology techniques. Antibody fragments and aptamers and single-stranded
5 oligonucleotides such as those derived from an *in vitro* evolution protocol referred to as SELEX and well known to those skilled in the art can also be used.

EXAMPLES

The present invention is further described by the
10 following examples. The examples are provided solely to illustrate the invention by reference to specific embodiments. These exemplifications, while illustrating certain specific aspects of the invention, do not portray the limitations or circumscribe the scope of the disclosed invention.

15 The examples are carried out using standard techniques, which are well known and routine to those of skill in the art, except where otherwise described in detail. Routine molecular biology techniques of the following example can be carried out as described in standard laboratory manuals, such as Sambrook
20 et al., MOLECULAR CLONING: A LABORATORY MANUAL, 2nd Ed.; Cold Spring Harbor Laboratory Press, Cold Spring Harbor, N.Y. (1989).

Real-Time quantitative PCR with fluorescent Taqman probes is a quantitation detection system utilizing the 5'- 3'
25 nuclease activity of Taq DNA polymerase. The method uses an internal fluorescent oligonucleotide probe (Taqman) labeled with a 5' reporter dye and a downstream, 3' quencher dye. During PCR, the 5'-3' nuclease activity of Taq DNA polymerase releases the reporter, whose fluorescence can then be detected
30 by the laser detector of the Model 7700 Sequence Detection System (PE Applied Biosystems, Foster City, CA, USA).

Amplification of an endogenous control is used to

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standardize the amount of sample RNA added to the reaction and normalize for Reverse Transcriptase (RT) efficiency. Either cyclophilin, glyceraldehyde-3-phosphate dehydrogenase (GAPDH) or 18S ribosomal RNA (rRNA) is used as this endogenous control. To calculate relative quantitation between all the samples studied, the target RNA levels for one sample were used as the basis for comparative results (calibrator). Quantitation relative to the "calibrator" is obtained using the standard curve method or the comparative method (User Bulletin #2: ABI PRISM 7700 Sequence Detection System).

To evaluate the tissue distribution, and the level of ESBPIII in normal and tumor tissue, total RNA was extracted from normal tissues, tumor tissues, and from tumors and the corresponding matched normal tissues. Subsequently, first strand cDNA was prepared with reverse transcriptase and the polymerase chain reaction was done using primers and Taqman probe specific to ESBPIII. The results are analyzed using the ABI PRISM 7700 Sequence Detector. The absolute numbers are relative levels of expression of ESBPIII compared to the calibrator tissue.

The absolute numbers depicted in Table 1 are relative levels of expression of ESBPIII in 12 normal different tissues. All the values are compared to normal mammary gland (calibrator). These RNA samples are commercially available pools, originated by pooling samples of a particular tissue from different individuals.

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Table 1: Relative Levels of ESBPIII Expression in Pooled Samples

Tissue	NORMAL
Brain	0
Heart	0
Kidney	0
Liver	0
Lung	0
Breast	1
Prostate	0
Small Intestine	0
Spleen	0
Testis	1
Thymus	0
Uterus	59

The relative levels of expression in Table 1 show that the highest level of expression of ESBPIII mRNA is in uterus (59), with expression also in mammary gland (1), and testis (1). These results establish that ESBPIII mRNA expression is highly specific for uterus and breast in gynecologic tissues, and testis for male tissues.

The absolute numbers in Table 1 were obtained analyzing pools of samples of a particular tissue from different individuals. They can not be compared to the absolute numbers originated from RNA obtained from tissue samples of a single individual in Table 2.

The absolute numbers depicted in Table 2 are relative levels of expression of ESBPIII in 55 pairs of matching samples, ovarian cancer samples from 5 different individuals, and normal ovarian samples from 5 different individuals. All the values are compared to normal mammary gland (calibrator). A matching pair is formed by mRNA from the cancer sample for a particular tissue and mRNA from the normal adjacent sample for that same tissue from the same individual.

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Table 2: Relative Levels of ESBPIII Expression in Pooled Samples

	Sample ID	Tissue	Cancer Tissue	Normal Adjacent Tissue	Normal Tissue
5	End10479	Endometrium 1	0	2	
	End8911	Endometrium 2	1413	274	
	Endo12XA	Endometrium 3	19	9	
	Endo28XA	Endometrium 4	1680	174	
	Endo3AX	Endometrium 5	4	4	
10	Endo5XA	Endometrium 6	97	454	
	Endo65RA	Endometrium 7	192	12	
	Endo8XA	Endometrium 8	1	485	
	End8963	Endometrium 9	1413	4	
	End4XA	Endometrium 10	1	0	
15	End68X	Endometrium 11	984	1714	
	Bld32XK	Bladder 1	0	0	
	Bld46XK	Bladder 2	0	0	
	ClnAS45	Colon 1	0	0	
	ClnRC01	Colon 2	1	3	
20	ClnB34	Colon 3	0	0	
	CvxKS52	Cervix 1	0	0	
	CvxNKS18	Cervix 2	0	0	
	CvxNKs80	Cervix 3	0	0	
	Kid107XD	Kidney 1	0	1	
25	Kid106XD	Kidney 2	2	1	
	Liv15XA	Liver 1	0	0	
	Liv94XA	Liver 2	0	0	
	Lng60XL	Lung 1	0	1	
	LngC20X	Lung 2	0	0	

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5	Mam47XP	Breast 1	1	0	
	Mam82XI	Breast 2	0	1	
	MamA06X	Breast 3	1	0	
	MamB011X	Breast 4	0	0	
	Mam59X	Breast 5	0	0	
10	Mam162X	Breast 6	0.03	0.14	
	Mam19DN	Breast 7	133.09	2.04	
	Mam220	Breast 8	0.48	0.27	
	Mam76DN	Breast 9	0.51	10.46	
	MamS079	Breast 10	0.07	0.12	
15	MamS127	Breast 11	0.52	0.44	
	MamS621	Breast 12	0.07	0.39	
	Pan71XL	Pancreas 1	0	0	
	Pan82XP	Pancreas 2	0	0	
	Pro18XB	Prostate 1	0.0	0.3	
20	Pro20XB	Prostate 2	3.3	1.3	
	Pro69XB	Prostate 3	0	0.3	
	Pro90XB	Prostate 4	0	0	
	Pro65XB	Prostate 5	0	3	
	SmInt21XA	Small Intestine 1	0	0	
25	SmInH89	Small Intestine 2	0	0	
	StoAC44	Stomach 1	0	4	
	StoAC99	Stomach 2	2	5	
	Tst39X	Testis 1	0	0	
	Utr135XO	Uterus 1	19	14	
25	Utr141XO	Uterus 2	25	3	
	Utr85XU	Uterus 3	1148	680	
	Utr23XU	Uterus 4	1013	60	

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	Ovr103X	Ovary 1	111	0	
	Ovr130X	Ovary 2	0	3	
	Ovr1005	Ovary Cancer 1	28		
	Ovr1040	Ovary Cancer 2	60		
5	Ovr1157	Ovary Cancer 3	109		
	Ovr63A	Ovary Cancer 4	0		
	Ovr1028	Ovary Cancer 5	0		
	Ovr230A	Ovary Normal 1			0
	Ovr32RA	Ovary Normal 2			0
10	Ovr40G	Ovary Normal 3			0
	Ovr35GA	Ovary Normal 4			0
	Ovr9RA	Ovary Normal 5			0

0= Negative

In the analysis of matching samples, the higher levels of expression for ESBPIII were in uterus, endometrium, ovary, and breast. This pattern shows a high degree of specificity for female gynecologic tissues, especially for endometrium, uterus, and ovary. These results confirmed the tissue specificity results obtained with the panel of normal pooled samples (Table 1) for uterus and breast.

Furthermore, the levels of mRNA expression in cancer samples and the isogenic normal adjacent tissue from the same individual were compared. This comparison provides an indication of specificity for the cancer stage (e.g. higher levels of mRNA expression in the cancer sample compared to the normal adjacent). Table 2 shows overexpression of ESBPIII in 6 primary endometrial cancer tissues compared with their respective normal adjacent (endometrium samples #2, 3, 4, 7, 9 and 10). There was overexpression in the cancer tissue for 54.54% of the endometrial matching samples tested (total of 11

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endometrium matching samples).

ESBPIII is differentially expressed in the four matching samples for uterine cancer. All four samples analyzed showed overexpression in cancer. Of twelve breast
5 cancer matching samples analyzed, five showed underexpression of ESBPIII (#2, 6, 9, 10 and 12) in cancer, whereas five had higher levels of ESBPIII in cancer compared to the normal adjacent tissue (#1, 3, 7, 8, and 11). Two of the breast matching samples do not show
10 expression of ESBPIII mRNA.

ESBPIII is differentially expressed in the two matching samples for ovarian cancer. Sample #1 shows upregulation for the mRNA of ESBPIII in cancer, whereas sample #2 shows overexpression in the normal adjacent
15 tissue. In addition to the two matching samples, ten additional samples for ovary were analyzed including five cancer samples and five normal ovary tissue samples from different individuals. Expression of ESBPIII mRNA was observed in three of the cancer samples (#1, 2, and 3).
20 The median expression in the ovary cancer samples was 28.1, whereas expression in the normal ovary samples was 0.

Altogether, the high level of tissue specificity for gynecological tissues, plus the mRNA differential
25 expression in several of the primary uterus, endometrial, breast, and ovarian matching samples tested is indicative of ESBPIII being a diagnostic marker for gynecologic cancers including uterine, endometrial, breast, and ovarian cancer.

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What is claimed is:

1. A method for diagnosing the presence of a gynecologic cancer in a patient comprising:

(a) measuring levels of ESBPIII in cells, tissues or
5 bodily fluids in a patient; and

(b) comparing the measured levels of ESBPIII with levels of ESBPIII in cells, tissues or bodily fluids from a normal human control, wherein a change in measured levels of ESBPIII in said patient versus normal human
10 control is associated with the presence of a gynecologic cancer.

2. A method of diagnosing metastases of a gynecologic cancer in a patient comprising:

(a) identifying a patient having a selected cancer
15 that is not known to have metastasized;

(b) measuring ESBPIII levels in cells, tissues, or bodily fluid from said patient; and

(c) comparing the measured ESBPIII levels with levels of ESBPIII in cells, tissue, or bodily fluid of a normal
20 human control, wherein an increase in measured ESBPIII levels in the patient versus the normal human control is associated with a cancer which has metastasized.

3. A method of staging a gynecologic cancer in a patient having a gynecologic cancer comprising:

25 (a) identifying a patient having a gynecologic cancer;

(b) measuring ESBPIII levels in cells, tissue, or bodily fluid from said patient; and

(c) comparing measured ESBPIII levels with levels of
30 ESBPIII in cells, tissues, or bodily fluid of a normal human control, wherein an increase in measured ESBPIII

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levels in said patient versus the normal human control is associated with a cancer which is progressing and a decrease in the measured ESBPIII levels is associated with a cancer which is regressing or in remission.

5 4. A method of monitoring a gynecologic cancer in a patient for the onset of metastasis comprising:

(a) identifying a patient having a gynecologic cancer that is not known to have metastasized;

10 (b) periodically measuring levels of ESBPIII cells, tissues, or bodily fluid from said patient; and

15 (c) comparing the periodically measured ESBPIII levels with levels of ESBPIII in cells, tissues, or bodily fluid of a normal human control, wherein an increase in any one of the periodically measured ESBPIII levels in the patient versus the normal human control is associated with a cancer which has metastasized.

5 5. A method of monitoring the change in stage of a gynecologic cancer in a patient comprising:

20 (a) identifying a patient having a gynecologic cancer;

(b) periodically measuring levels of ESBPIII in cells, tissues, or bodily fluid from said patient; and

25 (c) comparing the periodically measured ESBPIII levels with levels of ESBPIII in cells, tissues, or bodily fluid of a normal human control, wherein an increase in any one of the periodically measured ESBPIII levels in the patient versus the normal human control is associated with a cancer which is progressing in stage and a decrease is associated with a cancer which is regressing in stage or
30 in remission.

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6. The method of claim 1, 2, 3, 4 or 5 wherein the ESBPIII comprises SEQ ID NO:1 or SEQ ID NO:2.

7. A method of imaging a gynecologic cancer in a patient comprising administering to the patient an antibody which specifically binds to ESBPIII.

8. The method of claim 7 wherein said antibody is labeled with paramagnetic ions or a radioisotope.

9. A method of treating a gynecologic cancer in a patient comprising administering to the patient an antibody which specifically binds to ESBPIII.

10. The method of claim 9 wherein the antibody is conjugated to a cytotoxic agent.

PCT

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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(72) Inventor; and			
(75) Inventor/Applicant (for US only): MACINA, Roberto, A. [AR/US]; 4118 Crescendo Avenue, San Jose, CA 95136 (US).			
(74) Agents: LICATA, Jane, Massey et al.; Law Offices of Jane Massey Licata, 66 E. Main Street, Marlton, NJ 08053 (US).			
(54) Title: A NOVEL METHOD OF DIAGNOSING, MONITORING, STAGING, IMAGING AND TREATING GYNECOLOGIC CANCERS			
(57) Abstract The present invention provides a new method for detecting, diagnosing, monitoring, staging, prognosticating, imaging and treating gynecologic cancers including uterine, breast, endometrial and ovarian cancer.			

Docket No.
DEX-0180

Declaration and Power of Attorney For Patent Application

English Language Declaration

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

A Novel Method of Diagnosing, Monitoring, Staging and Treating Gynecological Cancers

the specification of which

(check one)

☐ is attached hereto.

☒ was filed on 30 September 1999 as United States Application No. or PCT International Application Number PCT/US99/22753 and was amended on _____

(if applicable)

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119(a)-(d) or Section 365(b) of any foreign application(s) for patent or inventor's certificate, or Section 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate or PCT International application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s)

Priority Not Claimed

_____ (Number)	_____ (Country)	_____ (Day/Month/Year Filed)	<input type="checkbox"/>
_____ (Number)	_____ (Country)	_____ (Day/Month/Year Filed)	<input type="checkbox"/>
_____ (Number)	_____ (Country)	_____ (Day/Month/Year Filed)	<input type="checkbox"/>

I hereby claim the benefit under 35 U.S.C. Section 119(e) of any United States provisional application(s) listed below:

60/102,743	2 October 1998
_____ (Application Serial No.)	_____ (Filing Date)
_____ (Application Serial No.)	_____ (Filing Date)
_____ (Application Serial No.)	_____ (Filing Date)

I hereby claim the benefit under 35 U. S. C. Section 120 of any United States application(s), or Section 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. Section 112, I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, C. F. R., Section 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application:

_____ (Application Serial No.)	_____ (Filing Date)	_____ (Status) (patented, pending, abandoned)
_____ (Application Serial No.)	_____ (Filing Date)	_____ (Status) (patented, pending, abandoned)
_____ (Application Serial No.)	_____ (Filing Date)	_____ (Status) (patented, pending, abandoned)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. (list name and registration number)



26259

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JC08 Rec'd PCT/PTO 29 MAR 2001

SEQUENCE LISTING

<110> Macina, Roberto A.
DIADEXUS LLC

<120> A Novel Method of Diagnosing, Monitoring, Staging,
Imaging and Treating Gynecologic Cancers

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